with the remains were numerous flint implements and a few worked in bone, as well as a number of perforated shells belonging to the genera *Nassa*, *Buccinum*, *Cypræa*, etc.; these, from their position, had evidently formed parts of a necklace and bracelets, and were interred with the body. The extreme friability of the bones did not allow of their removal in so perfect a condition as that of the first skeleton, but, in this case also, they belonged to a tall individual, the skeleton measuring nearly two metres in length. In the débris of the cave, bones of the following animals were met with:— *Ursus spelœus*, *Hyœna spelœa*, *Canis lupus* and *vulpes*, *Arctomys primigenia*, *Lepus cuniculus*, *Mus*, *Equus caballus*, *Sus scrofa*, *Bos primigenius*, *Cervus Canadensis*, *Elaphus corsicus* and *capreolus*, and *Capra primigenia*. Besides there were found some bones of a large eagle and of some birds of passage, as well as numerous species of marine shells of the genera *Patella*, *Pectunculus*, *Mytilus*, *Pecten*, *Dentalium*, and *Trochus*.— *The Academy*.

MICROSCOPY.

Apertures of Objectives.—The full report having been received of the London examination of the Tolles' $\frac{1}{10}$ inch objective sent there for measurement, it appears that unfortunately the examiners were thrown off their guard by an unexpected element in the case, and that, incredible as it may seem, their report does not touch the real question at issue. Everybody knows that an objective with cover-adjustment possesses a certain range of powers and angular apertures; and no one doubts that Mr. Tolles can make an objective of 145° aperture in air, or that the corresponding apertures would be 91° in water and 79° in thinned balsam. The one question in regard to this objective is not its balsam angle at an adjustment, dry, upon an accidentally or arbitrarily chosen object and the corresponding immersion angles, but its balsam angle at its highest (working) adjustment. If, from faulty mounting, the adjustment can be screwed past the limit of good definition, then of course it ceases to be an achromatic objective at all, and its angle beyond such limit is not worth talking about. The examiners do not state, however, that they examined the combination at its highest available angle dry, still less at its highest available angle immersed. Mr. Tolles' prominence as a successful maker of objectives gives a certain value to his statements even when they seem arbitrary; and it is to be hoped that

the secret of his peculiar belief in this case may be fully studied out, notwithstanding the unscientific method which he has chosen, in this instance, of appealing from principles to facts.

The principle involved in this discussion has long been understood. An objective varies in working focal length, and in angular aperture, according to the medium through which it works; and this variation has a definite ratio to the refractive indices of the media compared. By a simple and undisputed mathematical computation, the sine of the semi-aperture in air is to the sine of its semi-aperture in another medium, as the index of refraction of that medium is to the index of air: or, as the index of air is unity, the sine of its semi-aperture in any medium is equal to the sine of its semi-aperture in air divided by the index of the other medium. This theoretical ratio is easily verified by experiment, as instanced by Mr. Brakey in the case under consideration, where an angle of 145° in air should give a fraction over 91° in water and 79° in balsam so thin that its index was an arithmetical mean between that of balsam and that of turpentine, while in hard balsam having an index of 1.549 its aperture would have fallen to 76°. As the angle in air approaches the extreme limit of 170° or upwards, the balsam angle rises so slowly that the above 79° would scarcely reach 83°, the extreme angle for pure balsam being necessarily still smaller. This reasoning assumes only that the extreme ray above the front combination, capable of entering into the image when the objective is worked dry, is the extreme also when adjusted for immersion work.

Mr Tolles has uniformly declined either to accept or to controvert this well known theory, preferring simply to offer proof of his ability to excel this limit, without reconciling such result with the mathematical doctrine. Whether he utilizes rays beyond the extreme ray dry, or whether he measures rays not capable of forming a (good) image he does not state, and we can only conjecture. His early publications seem to claim "collecting" power for more extreme rays; but his letter to the March number of the Monthly Mic. Jour. practically disclaims this doctrine, and hints at a higher refracting power than crown glass has, in the front lens, as the secret of his excessive angle. Curiously this letter happens to be published in the same number with Mr. Brakey's explanation that the result is independent of the quality of the first lens, its index of refraction occurring twice in the computation in such positions as to cancel itself.

Mr. Wenham evidently does not recognize the possibility of "collecting," by means of posterior combinations, rays more divergent (behind the front lens) than those which are extreme when the objective is worked dry; and Mr. Tolles distinctly disavows this theory for his side of the controversy: yet it seems neither absurd nor improbable, and it is most likely the expedient by which the balsam angle is to be increased beyond 82°.

Since the above was in type Dr. J. J. Woodward has published an important contribution on this subject in the Monthly Mic. Jour. A $\frac{1}{10}$ was sent to him in February by Mr. Tolles for examination. It gave good definition, through glass one seventy-fifth of an inch thick, at its point of highest cover-adjustment; but at such adjustment its aperture could not be satisfactorily measured by the tank method. He therefore contrived an ingenious modification of the card-board method, throwing parallel solar rays through the objective from above, and measuring, in a darkened room, the inverted cone of a light below the focus of the objective, by bisecting this cone of light with a thin flat tank filled with balsam or other medium, the objective being attached, immersion fashion, to the surface of the medium. The illuminated portion of the medium was easily seen and measured. This method gave a balsam angle of not over 80° to the $\frac{1}{10}$ sent to him by Tolles for measurement, as well as to other Tolles' lenses previously furnished by that maker. On being apprised of this result Mr. Tolles sent a $\frac{1}{5}$, which gave a balsam angle of 90° to 100°, according to adjustment. This objective was peculiarly constructed, having four combinations instead of three; it could not be worked dry, nor could it work through any but a very thin cover. Dr. Woodward, and Prof. Simon Newcomb and Mr. Renel Keith, who examined the lens with him, attributed the excessive angle to the cause already alluded to, the employment of rays, which if the lens were worked dry would be beyond the limits of transmission, and would therefore suffer total reflection.

Mounting in Balsam.—Mr. W. H. Walmsley's success in mounting objects gives great value to his practical suggestion contributed to Science Gossip. He regrets that beginners should be confronted with spring clips, spirit lamps, and over-heated balsam, when balsam, dried to the point of brittleness and then dissolved to the consistency of rich cream in chemically pure benzole, would obviate the necessity for such annoyances. He frees the speci-

men from moisture by drying or preferably by passing successively through weak and absolute alcohol, treats it with oil of cloves which is more desirable than turpentine because more readily miscible with balsam and not calculated to harden the specimens even if they are left in it for a long time, transfers it to the slide and arranges it with needles, places a drop of the balsam solution on it and applies the glass cover in the usual manner. In a few days the mount will be sufficiently hardened to be handled with safety, especially if after twenty-four hours it should be slightly warmed and the cover carefully pressed down with the forceps and held down with a small weight. The best finish for the edge of the circle he finds to be the same balsam that is used in mounting, laid on with a camel's hair pencil; since this is neat and handsome, and will not spoil the specimen by running in, as may happen with colored varnishes.

UNMOUNTED MICROSCOPIC OBJECTS.—Mr. Jno. H. Martin, of Week street, Maidstone, England, is supplying a great want of microscopists by furnishing unmounted objects for the use of amateurs. His price for two dozen objects, post free, to the United States, is one dollar.

RESOLUTION OF FRUSTULIA SAXONICA INTO ROWS OF DOTS. After my new Tolles $\frac{1}{50}$ immersion had resolved the lines of *Amphipleura pellucida* into beading, I succeeded in obtaining a slide of *Frustulia Saxonica*, mounted dry by J. D. Moller. This test is somewhat easier than the *Amphipleura*, but more difficult dry than *Grammatophora subtilissima* is in balsam, or at least I find it so by lamp light, although both are satisfactorily shown. The following measurements were made with the Tolles $\frac{1}{50}$ objective, No. 2 eye-piece, and camera lucida; amplification 4000 times.

Using an ammonio-sulphate of copper cell and sunlight, the transverse striæ of the *Frustulia* are brought out without the least difficulty. The average number of lines to the thousandth of an inch, in fifteen measurements on different frustules, was eighty-nine. This agrees essentially with the counts of Dippel and Dr. Woodward.

I also succeeded in bringing plainly to view longitudinal lines which were counted in the same way. The average of fifteen counts was ninety-five to the thousandth of an inch. The lowest number observed was eighty-eight, the highest one hundred.

These lines I found more difficult than the transverse ones on *Amphipleura pellucida*, but patent enough to be accurately counted. It appears then that Dr. Woodward was correct in regarding the longitudinal striæ of Dippel as diffraction phenomena, for they were much coarser than the true lines, being as given by him only about 50,000 to the inch.

Thus far everything was done with ease. Then with care the bright apparently raised lines were transformed into rows of beads, this resolution into dots being accomplished in a satisfactory manner.

The results stated above have been repeatedly verified. I also resolve into beads, with the $\frac{1}{50}$, *Navicula crassenervis*, *Striatella unipunctata* and any *Pleurosigma*.—G. W. Morehouse.

Mould on Bread.—Messrs. Rochard and Legros express the belief, in "Comptes Rendus," that this frequent parasitic vegetation is due rather to the poor quality of the flour, or to bad management, than to the presence of germs in the air, and that it may be prevented by adding an excess of salt to the bread.

Effects of Dyeing Wool.—M. Dumas has been investigating the question whether wool, and similar hairs, are penetrated by the coloring material, or only colored externally in the process of dyeing. In fresh wool he found all the layers perfect; but in bleached wool the outer or cortical layer was marred or destroyed. Fibres dyed with indigo, without boiling, contained granules of the coloring matter between the cells; while hairs which had been boiled in alumina and iron solutions appeared twisted or corroded.

Microscopic Eyes.—In the absence of any further information, and indeed in spite of any possible information, the newspaper story of the boy with microscopic eyes may safely be regarded as a curious hoax, founded on the magnifying power of shortsighted eyes as compared with longsighted ones. One eye may be calculated to form an image twice as large as another eye, or, by an extraordinary deformity, several times as large; but it would be no longer a human eye if capable of giving the high powers of the microscope. That the author of the hoax did not even aim at consistency or plausibility is seen in the representation that the boy was able to use for ordinary purposes the eyes that were capable, unaided, of resolving diatoms.

ECONOMICAL VALUE OF RAPHIDES.—Mr. F. C. S. Roper suggested to the Eastbourne Nat. Hist. Soc. the value of raphides as tests of the genuineness of certain medicinal substances obtained from plants containing them. Though not new, this method of detecting adulterations or falsifications is capable of a greatly increased usefulness.

PATHOLOGY OF MALIGNANT TUMORS.—Dr. W. B. Neftel, in a contribution to the Archives of Scientific and Practical Medicine, advocates the doctrine that cancer is primarily a purely local disease, due to mechanical or chemical irritation. Thus we notoriously find it usually originating in localities most constantly subject to such causes. Afterwards it becomes generalized by means of the lymphatics and blood vessels, and affects other and distant organs; and the unsuspected promptness with which this takes place occasions the frequent failure of local curative treatment. The existence of a hereditary disposition to malignant tumors, not in the congenital acquisition of morbid germs, but in the inheritance of a faulty structure or arrangement of tissues or organs, which thus offer less resistance to the causes of disease, is not denied, but is believed to have been greatly exaggerated.

VITALITY FROM GERMS.—As a reaction from the always fascinating doctrine that organic germs of various kinds, when introduced into the system of larger animals, have a tendency to cause disease and destruction, it has been recently surmised, without attempt at proof, that such germs may actually impart and increase vitality.

OBITUARY.—Mr. James How, a well known philosophical instrument maker of London, formerly with George Knight and Son, of London, and lately successor to them, died suddenly, Dec. 8, 1872. Mr. How will be remembered for his skill in the use of the microscope, but especially for his prominence among those who took the lead in introducing students' microscopes of good quality and cheap price.

NOTES.

THE meeting of the American Association at Portland next month bids fair to be one of the largest held for several years, and we understand that quite a number of titles of papers to be